Correlation of DIAL Ozone Observations with Lightning

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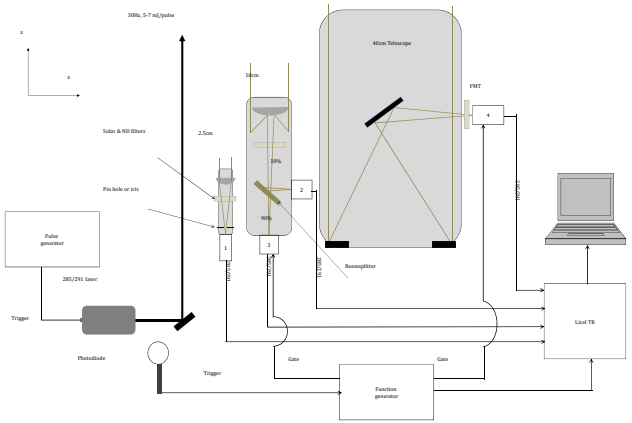
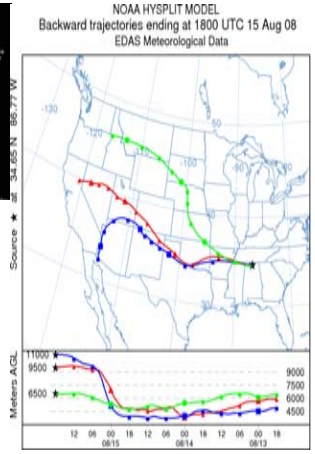
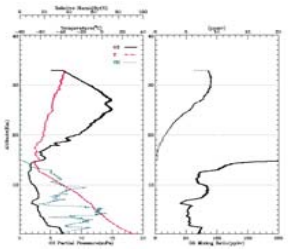
The purpose of this project is to see whether ozone maxima measured by the **DIfferential Absorption Lidar** (DIAL) instrument in Huntsville, AL may be traced back to lightning events occurring 24-48 hours beforehand. The methodology is to start with lidar measurements of ozone from UAH's DIAL instrument (Kuang et al. 2013) and/or ozonesonde measurements.

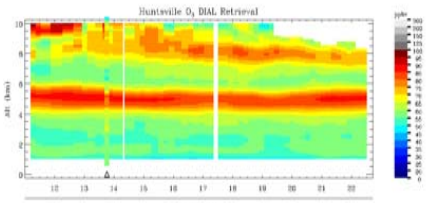


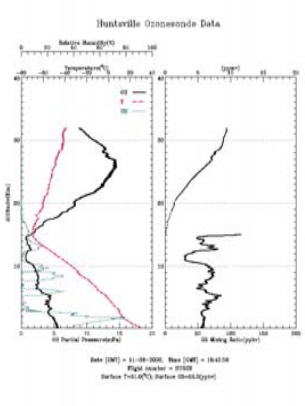
In this case an ozone maximum at above 9500 m above ground level was co-located with a water vapor maximum, pointing to thunderstorm origins rather than the stratosphere. The back trajectory takes it to a lightning active region in the TX panhandle on the 13th, and just below 6 km above ground level (**a favorable altitude for lightning NOx production**).

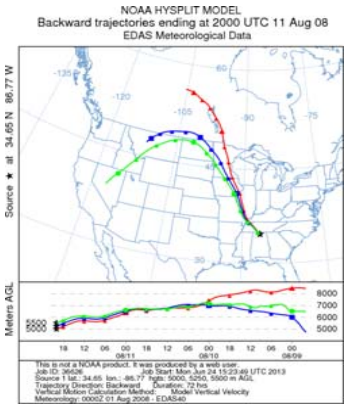




The target here is ozone at 5.25 km at 2000 UTC tracing back to lightning in central Montana, and also traces back from the top of the ozone layer at 5.5 km to lightning in northeast Nevada and southern Idaho, though **higher** than the favored 6 km lightning NOx injection height. The ozonesonde and accompanying water vapor data indicate a sharp transition through this ozone maximum, with the lower half being substantially drier than the upper half. The lower half is likely to be stratospheric ozone, indicated by the dry air and the subsident back trajectory at 5 km, while the upper half is likely to be thunderstorm induced as indicated by relatively more moist air and substantially less net vertical motion through the back trajectory at 5.25 and 5.5 km (in addition to the trajectory tracing back to lightning activity).







In conclusion this type of analysis strongly suggests that lightning produced ozone precursors may be responsible for some of the ozone maxima over Huntsville. In three of the six cases (four not shown) the precursors are carried on a northwesterly jet stream; in the other three, a westerly jet stream.

A future goal of this project is to use the Lightning Nitrogen Oxides Model (Koshak et al. 2013) to calculate the nitrogen oxide injection from lightning to further quantify ozone resulting from lightning activity. Alternately, a portable lidar would allow greater flexibility in testing for lightning-produced ozone maxima by allowing one to move the lidar to the site predicted by HYSPLIT to be 24-48 hours downstream of a lightning event over an LMA as it occurs.

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